

CLAIMS

1. An antenna system including a coverage antenna with a coverage beam pattern; and an auxiliary antenna with an auxiliary beam pattern, wherein said auxiliary beam pattern has a mainlobe with:
 - a) an amplitude lower than an amplitude of a mainlobe of said coverage beam pattern;
 - b) a width lower than a width of said mainlobe of said coverage beam pattern;
 - c) a phase different to a phase of a sidelobe of said coverage beam pattern; and
 - d) a direction which is selected so as to at least partially suppress said sidelobe.
2. An antenna system according to claim 1 wherein said width of said mainlobe of said auxiliary beam pattern is substantially equal to a width of said sidelobe.
3. An antenna system according to claim 1 wherein the phase difference between said mainlobe of said auxiliary beam pattern and said sidelobe of said coverage beam pattern lies in the range 157.5° to 202.5° .
4. An antenna system according to claim 1 wherein said direction of said mainlobe of said auxiliary beam pattern is substantially aligned with said direction of said sidelobe.
5. An antenna system according to claim 1 wherein said antenna system is operable in a receive mode.

6. An antenna system according to claim 1 wherein said antenna system is operable in a transmit mode.
7. An antenna system according to claim 1 wherein said antenna system is operable in a receive mode and in a transmit mode.
8. An antenna system according to claim 7 wherein said system receives signals at a first frequency in said receive mode, and transmits signals at a second frequency in said transmit mode.
9. An antenna system according to claim 1 including a variable phase shifter for varying said phase of said mainlobe of said auxiliary beam pattern.
10. An antenna system according to claim 1 including an attenuator for lowering said amplitude of said mainlobe of said auxiliary beam pattern.
11. An antenna system according to claim 10 wherein said attenuator is a motorized electromechanical attenuator.
12. An antenna system according to claim 1 wherein said coverage antenna has a smaller length than said auxiliary antenna.
13. An antenna system according to claim 1 wherein said coverage antenna has a smaller number of antenna elements than said auxiliary antenna.
14. An antenna system according to claim 1 wherein said mainlobe of said auxiliary beam pattern has a width in a vertical plane which is lower than a width of said mainlobe of said coverage beam pattern in a vertical plane.
15. An antenna system according to claim 1 wherein said mainlobe of said coverage beam is downwardly downtilted.

16. An antenna system according to claim 1 wherein a downtilt angle of said mainlobe of said auxiliary beam pattern is different to a downtilt angle of said mainlobe of said coverage beam pattern.
17. An antenna system according to claim 16 wherein said downtilt angle of said mainlobe of said auxiliary beam pattern is lower than said downtilt angle of said mainlobe of said coverage beam pattern.
18. An antenna system according to claim 1 including a phase shifter for electrically steering said auxiliary beam pattern.
19. An antenna system according to claim 1 wherein said antenna system is configured to operate at a selected wavelength λ , and the spacing between said coverage antenna and said auxiliary antenna is less than 1.3λ .
20. An antenna system according to claim 19 wherein the spacing between said coverage antenna and said auxiliary antenna is less than 1.0λ .
21. An antenna system according to claim 1 including a substantially planar reflector for reflecting radiation to and/or from said coverage antenna.
22. An antenna system according to claim 1 including a substantially planar reflector for reflecting radiation to and/or from said auxiliary antenna.
23. An antenna system according to claim 22 wherein said substantially planar reflector also reflects radiation to and/or from said coverage antenna.
24. A mobile communications wireless network including two or more antenna systems according to claim 1, each system being arranged to communicate

with mobile devices in a respective coverage area; and a network controller coupled to said antenna systems.

25. An antenna system including a coverage antenna with a coverage beam pattern; an auxiliary antenna with an auxiliary beam pattern having a mainlobe with an amplitude, width, and direction selected so as to modify said coverage beam pattern; and a transmit/receive system for receiving uplink signals from said antennas and transmitting downlink signals to said antennas.
26. An antenna system according to claim 25 wherein said auxiliary beam pattern has a mainlobe with a width lower than a width of a mainlobe of said coverage beam pattern.
27. An antenna system according to claim 25 wherein said transmit/receive system receives signals at a first frequency in said receive mode, and transmits signals at a second frequency in said transmit mode.
28. An antenna system according to claim 25 wherein a mainlobe of said auxiliary beam pattern is directed so as to adjust the position of a null of said coverage beam pattern.
29. An antenna system according to claim 25 wherein a mainlobe of said auxiliary beam pattern is directed so as to null-fill said coverage beam pattern.
30. An antenna system according to claim 25 wherein the auxiliary beam pattern has a phase selected so as to modify said coverage beam pattern.
31. An antenna system according to claim 30 including a variable phase shifter for varying a phase of said auxiliary antenna.

32. An antenna system according to claim 25 including an attenuator for lowering an amplitude of said auxiliary beam pattern.
33. An antenna system according to claim 32 wherein said attenuator is a motorized electromechanical attenuator.
34. An antenna system according to claim 25 wherein said coverage antenna has a smaller length than said auxiliary antenna.
35. An antenna system according to claim 25 wherein said coverage antenna has a smaller number of antenna elements than said auxiliary antenna.
36. An antenna system according to claim 25 wherein a mainlobe of said auxiliary beam pattern has a width in a vertical plane which is lower than a width of a mainlobe of said coverage beam pattern in a vertical plane.
37. An antenna system according to claim 25 wherein a mainlobe of said coverage beam is downwardly downtilted.
38. An antenna system according to claim 25 wherein a downtilt angle of a mainlobe of said auxiliary beam pattern is different to a downtilt angle of a mainlobe of said coverage beam pattern.
39. An antenna system according to claim 38 wherein said downtilt angle of said mainlobe of said auxiliary beam pattern is lower than said downtilt angle of said mainlobe of said coverage beam pattern.
40. An antenna system according to claim 25 including a phase shifter for electrically steering said auxiliary beam pattern.

41. An antenna system according to claim 25 wherein said antenna system is configured to operate at a selected wavelength λ , and the spacing between said coverage antenna and said auxiliary antenna is less than 1.3λ .
42. An antenna system according to claim 41 wherein the spacing between said coverage antenna and said auxiliary antenna is less than 1.0λ .
43. An antenna system according to claim 25 including a substantially planar reflector for reflecting radiation to and/or from said coverage antenna.
44. An antenna system according to claim 25 including a substantially planar reflector for reflecting radiation to and/or from said auxiliary antenna.
45. An antenna system according to claim 44 wherein said substantially planar reflector also reflects radiation to and/or from said coverage antenna.
46. A mobile communications wireless network including two or more antenna systems according to claim 25, each system being arranged to communicate with mobile devices in a respective coverage area; and a network controller coupled to said antenna systems.